

Auroras were most frequent in: Wisconsin, on eighteen days; Minnesota, on fourteen days; North Dakota, on ten days.

CANADIAN DATA—THUNDERSTORMS AND AURORAS.

Thunderstorms were reported at Port Stanley, 24th, 25th, and 31st, and at Medicine Hat, 28th.

Auroras were reported as follows: 1st, Winnipeg, Minnedosa, and Prince Albert. 3d, White River, Winnipeg, and Minnedosa. 11th, Prince Albert. 12th, Minnedosa and Prince Albert. 13th, Quebec, Minnedosa, and Medicine Hat. 14th, St. Andrews, Father Point, Quebec, Kingston, Rockcliffe, Port Stanley, Winnipeg, Minnedosa, Qu'Appelle, Medicine Hat, and Prince Albert. 15th, Father Point, Quebec, Rock-

cliffe, Winnipeg, and Minnedosa. 16th, Father Point, Quebec, Rockcliffe, Kingston, Port Arthur, Winnipeg, Minnedosa, Qu'Appelle, Medicine Hat, and Prince Albert. 17th, Father Point, White River, Port Arthur, and Medicine Hat. 18th, Kingston, Winnipeg, and Minnedosa. 20th, St. Andrews, Father Point, and Quebec. 21st, White River. 22d, Grand Manan, St. Andrews, Father Point, Montreal, Kingston, and Minnedosa. 23d, Father Point and White River. 24th, Father Point, Winnipeg, and Minnedosa. 25th, White River and Minnedosa. 26th, Winnipeg and Minnedosa. 28th, White River. 29th, Quebec and Medicine Hat. 30th, St. Andrews, Quebec, and Medicine Hat. 31st, Winnipeg and Battleford.

METEOROLOGY AND MAGNETISM.

By Prof. FRANK H. BIGELOW.

For general remarks relative to this subject see page 7 of the REVIEW for January, 1895.

The comparison of the air temperature with magnetic horizontal force is shown in detail on Chart V, and the special features of the March curves are as follows:

SPECIAL FEATURES OF THE MARCH CURVES.

The temperatures and also the magnetic force observations need no correction for slope; the amplitudes are not modified; the reduction to a zero datum line for temperatures is

+2 and for the horizontal magnetic force is -2. The new magnetic solar period begins March 11.80. If the more accurate period, 26.67928, is used instead of 26.68 days, for which the published ephemeris was constructed, the correction from the latter to the former for the year 1895 is 0.08 day.

Unfortunately for the purposes of this comparison the magnetic observatory at San Antonio suspended its operations about the first of March. We can therefore utilize only the readings of the instruments at Toronto and Washington.

INLAND NAVIGATION.

The extreme and average stages of water in the rivers during the current month are given in Table VII. The only river that was above the danger line was the Tennessee, at Johnsonville, on the 23d. The following rivers rose to nearly that point: the Ohio, at Evansville, 23d; the Congaree, at Columbia, 16th, and the Savannah, at Augusta, 17th.

The thickness of ice in rivers and harbors is given in the weekly bulletin of "Snow on the Ground" during the winter

months. On Monday, March 25, the Missouri river was open for some distance above Pierre, but above that there was reported 26 inches of ice at Bismarck and 33 inches at Williston. The Ohio was just clearing out at Pittsburg. At the Lake stations the reports showed 24 inches in the harbor and 12 in the lake at Duluth; none at Marquette; 22 at Sault Ste. Marie, and no fast ice at Milwaukee and Grand Haven; Alpena, 0.5; Port Huron, 5.0; Detroit, 6; Erie, 3; Rochester, 14; Oswego, 16.5.

STATE WEATHER SERVICES.

The following extracts are taken from the reviews published by the services of the respective States; occasional notes in brackets are added by the Editor:

Alabama.—Up to the 20th the month was cold and generally unfavorable; severe local windstorms occurred in different parts of the State on the 7th and again on the 20th; the heavy rains of the middle of the month caused very high rivers, amounting almost to floods in some places. The last ten days were generally warm and pleasant and favorable to all farm work, which has been pushed very rapidly. Rainfall was 1.83 more than the normal for the month.

Arizona.—The monthly mean temperature was 1.5° above normal; the precipitation was 1 inch below normal; the average weather was 18 clear days, 8 partly cloudy, 5 cloudy, and 1 rainy.

Arkansas.—The mean temperature for the month was 0.6° above the normal. For the first two decades the temperature was generally below the normal; after the 21st it was above the normal to the end of the month. The highest temperature ever recorded in the State in March occurred at Keesees Ferry, Marion County, on the 28th, when the maximum thermometer registered 91°. The average precipitation for the State was 0.41 inch above the normal. There was no snowfall during the month, except traces at Corning, Fayetteville, and Keesees Ferry.

California.—The month was deficient in both temperature and rainfall. The severe frosts of 14th, 15th, 29th, and 30th did considerable damage to the almonds, the early cherries, and especially to the apricots, which will considerably decrease the yield. Several fine orchards that had escaped the frost of the 14th and 15th were nearly destroyed by the frost of the 29th. All other fruits will be abundant.

The grain prospects continue good in all quarters of the State where raised. The abnormal weather of February had advanced the growth of fruits at least ten days earlier than usual, which was the cause of the damage done by this month's frosts.

Colorado.—The monthly mean temperature was 1°, and the average daily temperature from 5° to 7° below the normal for March. Precipitation was most general from 13th to the 15th, and on the 29th, 30th, and 31st. It was above the average in the north-central section and on the Divide, while in the San Luis Valley there was little or none, and a deficiency was also reported from the extreme eastern and southern countries and the western slope.

Connecticut.—(See *New England*.)

Delaware.—(See *Maryland*.)

District of Columbia.—(See *Maryland*.)

Florida.—There was no marked departure from normal conditions during the month. A moderate cold wave occurred in the first week, but only two stations reported temperatures below the freezing point and very little damage was done to vegetation. A cool wave in the third week of the month was accompanied by light frosts in some of the northern counties, but no injury resulted except the retarding effect on vegetable growth. The mean precipitation for the month was 0.84 inch below the normal for the State.

Georgia.—The month was marked by no unusual severe storms. The State was visited by several cold waves, the most noticeable of which took effect on the mornings of the 16th and 17th, and on the latter date caused the temperature to fall below or near freezing in the most southerly counties. The average temperature of the month for the State as a whole varied but little from the seasonal normal. The precipitation was less than a half inch below the normal.

Idaho.—The current month was generally fair; with light precipitation, until the 20th, when stormy conditions became general until the 23d. Rain or snow was reported in all sections from the 27th to the 29th.

Illinois.—The current month was ordinary and nearly normal, excepting for the great deficiency of precipitation (nearly or quite 2 inches), but the general rain of the 30th and 31st diminished this deficiency to 0.40 of an inch. The average temperature for the month was 1.4° above the normal as a consequence of the gradually increasing warmth from the 17th to the 30th, the 29th proving in many counties the warmest March day on record. The coolness of the first part of the month made the coming of spring seem late, but it must certainly be considered favorable, for it has made the danger of killing frosts more remote.

Indiana.—The average temperature for the State was very near normal; a slight excess is noted for the central and southern portions. Frosts were quite frequent, and ice formed on several nights. The drought continued during the month, and precipitation, mostly in the form of snow, fell in small quantities. The drought and cold weather checked the growth of the crops and delayed farm work. Some oats were sown, but little plowing for corn was done, and only a few gardens were made. Finally, rains and warmer weather caused wheat, rye, and grass to recover, and at the end of the month these crops were turning green and were in fair condition, promising good harvests.

Iowa.—The daily mean temperature was below normal during the first and second decades, but considerably above in the third. The average precipitation was 1.20 below the normal. This prevailing dry weather and the high winds which are characteristic of March caused severe and somewhat damaging duststorms on a number of days during the latter half of the month.

Kansas.—This current month was the reverse of March, 1894, respecting its warm days. The first twenty-one days being cool, when there was an accumulated deficiency of 86° at the central station; the temperature then rose rapidly, and at the end of the month there was an accumulated excess of 86°, making an average excess for the last ten days of 17° per day at Topeka. This was a comparatively dry month, there being an average deficiency of rainfall over the State of 0.62.

Kentucky.—The mean temperature of the current month was exactly normal, as determined from data taken from the records of the Weather Bureau stations at Louisville, Cairo, Cincinnati, and Lexington, and covering periods ranging from twelve to twenty-four years. There was a remarkable uniformity in the mean temperatures reported from different sections of the State. No periods of unusually severe cold occurred, but during the closing days of the month the highest temperatures within twenty-five years were recorded. Precipitation was deficient by little less than an inch, owing to its even distribution; however, it was abundant for all agricultural purposes.

Louisiana.—The current month, considering the State as a whole, averaged nearly 2° warmer than normal. Precipitation was about four-tenths of an inch more than usual. Frost occurred as far south as New Orleans on the 3d, and in various portions of the interior and northern parishes on the 5th, 17th, and 21st. The weather was, in general, favorable to agriculture, although in some portions of the State the crops are nearly a month late.

Maine.—(See *New England*.)

Maryland.—This was not a remarkable month as regards storms, temperature, or precipitation, although it varied considerably from the normal in some respects. Although the 9 anticyclones were outnumbered by the 10 cyclones, yet the influence of the former was somewhat the stronger, as indicated by the excess of fair days over rainy days, the considerable deficiency in rainfall, and the minus departure of temperature of from 1° to 2° per day.

Massachusetts.—(See *New England*.)

Michigan.—The monthly mean temperature was 3.8° below the normal. Every station in the State had a deficiency of precipitation, making the month a very dry one. The average snowfall was 6.0 inches. Clear weather prevailed in most sections of the State on the night of the 10th, and a majority of the observers noted the total eclipse of the moon.

Minnesota.—The month was especially noted for the almost total absence of any snow covering on the ground and the deficient precipitation, which was less than a third of the usual amount. High winds were frequent during the last decade, which, besides raising clouds of dust, also accelerated evaporation, causing the top soil to become exceedingly dry and, therefore, more susceptible to temperature changes. The only vegetation to be harmed, however, is a comparatively small amount of winter grain and fruit, and it is as yet too early to determine the amount of the injury sustained.

Mississippi.—High winds and cold and rainy weather prevailed for the most part during March until the 25th, rains being of almost daily occurrence until the 21st, after which dry, sunshiny weather lasted until the 30th. The cold and wet weather of the first two decades prevented any extensive farming operations, but good headway was made during the succeeding ten days. It was generally admitted that at the close of the month farm work was from two to three weeks behind time in all portions of the State.

Missouri.—The temperature was below the normal the greater part of the time until the 21st, but for the remainder of the month the weather

was unusually warm. During the last decade of the month the soil was in good condition to work, except in a few localities in the southern and central counties, where the heavy rains and snows had made it too wet, and by the 31st a large part of the oat crop had been sown, early gardens made, and some plowing done for corn. In some counties in the northern sections wheat was injured by drought and by drying winds during the last decade, and water continued very scarce in many localities.

Montana.—The temperature for the month was about 3° above the normal, while precipitation was about 0.21 inch below. The average number of clear days was 14; partly cloudy, 10; cloudy, 7. The coldest weather occurred from the 12th to 15th, and the warmest from the 25th to 28th.

Nebraska.—This was a rather dry month, with a mean temperature somewhat higher than usual. The extremes of temperature were considerable, ranging from 94° to -21°. The former is the highest temperature for March shown by our records, excepting in 1893, when it reached 96°, and the latter is also the lowest, excepting in 1891, when the temperature fell to -38°. The monthly mean temperature was a little more than a degree above the normal. Precipitation for the State averaged little more than half the normal amount.

Nevada.—During the month both the temperature and the precipitation were below the normal. The snowfall was less than normal, but came in rather well-distributed amounts. No farming operations, comparatively speaking, had commenced by the close of the month, plowing and seeding being retarded by the unusually low minimum temperatures which occurred during the nights. The cold weather has been very beneficial to the fruit prospect, delaying the budding and lessening to a great extent the liability to damage from late frosts. This has been a good year for cattle. Grass is now in excellent condition all over the State, and the stock which were turned out last month have been doing well.

New England.—The average temperature for the month was 0.6° below the normal. Many observers in the central and northwestern sections report it one of the coldest Marches on record. There was a good covering of snow in the fields at the end of the month and from 1 to 2 feet in the woods of the northern counties. Some correspondents report slight injury to the peaches in Massachusetts during the cold spell in February, but at present there is every promise of an immense crop of this fruit throughout New England. Other fruits have wintered well, except where raspberry bushes have been frozen above the snow covering. In the northern portions no farm work has been done and in the southern part the season is considered fully ten days behind the average.

New Hampshire.—(See *New England*.)

New Jersey.—The current monthly mean temperature and precipitation were both below the normal. Farming operations have not yet begun.

New Mexico.—The current monthly mean temperature averaged about the normal, probably a little below. The precipitation averaged considerably below the normal and was quite unevenly divided. The wind averaged light, considering that it is the most windy month of the year.

New York.—The average of the mean temperatures at 26 stations possessing records for previous years was 3.1° below the normal. The deficiencies were most marked in the northern and western parts of the State. The average precipitation at these stations was 1.03 inch below; average snowfall, 9.3 inches. The severest storms occurred on the 17th and 28th. The unusually high velocity of 64 miles per hour was recorded at New York on the latter date. Rain or snow fell in some portion of the State every day until the 16th and from the 24th to 31st, the intervening week being fair. Ice also continued in the upper Hudson River after the 31st.

North Carolina.—Although the monthly mean temperature was nearly exactly normal, March made the impression of being a cold, wet, disagreeable month on account of the frequent rains for the first three weeks; the last ten days were dry and warmer, the maximum temperatures approaching very near the high records of March, 1894. At the end of the month vegetation was very backward; forests not yet green and farming operations hardly begun. The precipitation was only 0.37 above the normal and very evenly distributed. The eclipse of the moon (total) was generally visible over the State, being obscured by clouds at a few places. A slight shock of earthquake on the 4th was reported by two observers in the western counties.

North Dakota.—The current March will be known as one of the driest months ever experienced in North Dakota, the precipitation for the State only averaging 0.16 of an inch. An examination of all records obtainable show that this is less than was ever recorded before in this State. The temperature was slightly higher than the average and the entire month was warm, with the exception of the 12th and 13th, when a cold wave passed over the State. At the end of the month no snow remained on the ground. Farming operations had not generally begun, although many farmers were plowing during the last ten days of the month and some seeding was done.

Ohio.—The month of March averaged only slightly below the normal as to temperature, but was decidedly below as to precipitation. The crops generally suffered from the drought and were needing rain badly

at the close of the month. As a whole the month was unfavorable and injurious to cereals and delayed the commencement of farm work by the continued low night temperatures freezing the ground and preventing its cultivation.

Oklahoma.—The temperature for March was about 3° above the normal; precipitation 1.34 of an inch below. At Buffalo, during a thunderstorm on the 10th, lightning set fire to the prairie 3 miles northeast of town and about 5,000 acres were burned over before the fire was put out by back firing. Another terrible fire extended both north and south of this town, by which many thousands of acres were burned over, feed, stacked hay, sorghum, and berries being destroyed.

Oregon.—Normal weather conditions prevailed during the current month, the mean temperature for the State being only 0.1° below the average, and 3.3° colder than the warmest March in the past six years. Precipitation, 0.10 inch below the normal. The sunshine was abundant throughout the State the first eighteen days, except the 11th and 12th. The days were quite warm and the nights not so cool as usual, so that the buds began to swell; even the several killing frosts did very little, if any, damage to the growing vegetation. Spring plowing and seeding were well advanced by the end of March and crops of all kinds in good condition. Lambing advancing rapidly and a large crop looked for. The date of general bloom of the fruit trees can safely be put down as March 25, though in some sections even earlier bloom prevailed.

Pennsylvania.—The average temperature for the month was 1.5° below the normal for the past seven years, and the average precipitation 1.26 inch below the normal for the same length of time. At the close of the month grain and grass appear to have wintered well, but all vegetation is backward, with but few signs of spring.

Rhode Island.—(See *New England*.)

South Carolina.—The current month was cooler than usual during the first half and warmer during the remainder, making the average temperature nearly normal. The rainfall was 1.25 inch in excess of the normal, and well distributed over the entire State. From the 20th to the end of the month but little or no rain fell. The excessive rainfall greatly interfered with farm work until this date, after which it progressed rapidly under favorable conditions.

South Dakota.—The first half of the month was cold and unseasonable, the remainder generally mild and more seasonable. Brisk to high winds prevailed much of the time, with a deficiency in precipitation over much of the State, rendering the top soil of plowed ground very dry and retarding seeding. The drought was succeeded generally by good rains and snows the last of the month, putting the ground in excellent condition for farm work.

Tennessee.—During the first three weeks of March abnormally low temperature and frequent rains retarded all farm work and prevented the growth of vegetation. The abnormally low temperatures and excessive rainfall of the first three weeks were followed by very warm weather in the last week, which caused vegetation to put forth rapidly

and practically opened the crop season of 1895. The prospects are still favorable for a large yield of fruits of all kinds.

Texas.—The temperature on an average for the State was 0.8° below the normal. The greatest deficiency was in the vicinity of Houston. The average precipitation was 0.62 inch below and not very well distributed. Farming operations are from one to two weeks late in comparison with past years' records, except cotton planting, which was apparently only five to eight days late at the close of the month. The crop prospects are good all over the State and the fruit trees are generally blooming nicely, with prospects for a good crop.

Utah.—The monthly mean temperature for the Territory was 5° below the normal; precipitation was also below. Two severe blizzards reported from Heber. Spring generally backward.

Vermont.—(See *New England*.)

Virginia.—Average monthly mean temperature for the current month 1.4° below the normal and precipitation about the normal for the State, being generally slightly above near the coast and least in the northern section. The prevailing rains and cool weather generally prevented farm work and preparation for spring crops until about and after the 25th, so that such work was thus thrown two or three weeks behind the average season. This was specially noticeable in the trucking sections. The generally cool temperature kept back the fruit bloom during the month, and thus increased the probability of a good fruit crop.

Washington.—The peculiar feature of the current month was the dry, warm, delightful weather of the first ten days, otherwise it was not an exceptionally warm month, the mean temperature being about the same as the normal for several years and the total rainfall not far below. In the western section the average temperature was lower than that of February, but in the eastern it was warmer. With the warm days at the beginning of the month the snow went off early and the farmers improved the chance to plow and prepare land for spring seeding, of which latter much was done. The heavy frosts of the 15th froze out considerable winter wheat, which had to be resown. There were no very severe gales, although the month was somewhat windy.

West Virginia.—The mean temperature for March was about 2° below the normal and the average rainfall about 0.25 inch below. Rain or snow fell at points within the State every day except the 30th and 31st.

Wisconsin.—The first half of the current month was unusually cold, with zero temperatures occurring at frequent intervals up to the 15th. The month was extremely dry, the average rainfall being 0.50 of an inch, or 1.5 inch less than the normal for March. Most of the precipitation occurred in the form of snow. The usual spring rains were missing, and, as a consequence, the lack of moisture was felt quite severely in some sections and retarded the thawing out of the soil.

Wyoming.—The mean temperature for the month was slightly below the March normal and the average amount of precipitation was considerably above the March normal. Grass starting and cottonwood trees beginning to bud.

STUDIES BY FORECAST OFFICIALS.

I.—LOWS NORTH OF IDAHO AND MONTANA.

By Prof. H. A. HAZEN (dated August 21, 1893).

The following is a report "on the probable effect of the occurrence during September of low pressure areas to the north of Idaho and Montana in determining the weather conditions in the Upper Mississippi Valley and Upper Lake region within the next thirty-six to forty-eight hours."

In the following statement a careful study has been made of the three-times-daily and twice-daily manuscript maps of the forecast division for the 16 Septembers from 1877 to 1892. In this report a small subscript figure indicates the map used, whether a. m. (1), p. m. (2), or night (3). Since 1888 there have been only two maps, a. m. (1) and p. m. (2).

DESCRIPTION OF THE MAPS.

1877.

- Sept. 6. Low in Montana; slow motion.
- 9. Moved to north Missouri.
- 9. In Illinois.
- 10. In Indiana; rain in Lower Lakes; none in upper.

1878.

- Sept. 7. Low in Dakota; slow motion.
- 9. Rain in Upper Lakes.
- 17. Low in Dakota.
- 19. Moved to Upper Lakes, with rain.

REV—2

- Sept. 23. Low in Montana.
- 24. In western Iowa; first rain in Upper Lakes.

1879.

- Sept. 8. Low near Montana; slow motion.
- 11. Moved to eastern Minnesota, with rain.

1880.

- Sept. 18-21. Marked low moving from north of Montana to north of Lakes; no rain. High to southeast, and later to south and southwest.
- 24-27. Another low above Lakes without rain.

1881.

- Sept. 8. In Montana.
- 9. Rain at St. Paul.
- 10. Rain, 1.31, La Crosse; 1.37, Omaha; 1.02, Dubuque.
- 13. Trough from Manitoba to Texas.
- 15. Formed or collected in a single storm in Indiana.
- 16. Western Wisconsin.
- 16. Northern Minnesota.
- 17. In Manitoba, moving a little northwest; heavy rain.
- 22. Northern Montana.
- 24. Minnesota; rain Upper Lakes; none lower.
- 25. In eastern Montana with trough south. General storm from Lakes to Texas with highs southeast and northwest.